

OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from the **DEEP SPOT STATIONS** of **LAKE SUNAPEE**, the program coordinators have made the following observations and recommendations.

FIGURE INTERPRETATION

- **Figure 1 and Table 1:** The graphs in Figure 1 (Appendix E) show the historical and current year chlorophyll-a concentration in the water column. Table 1 (Appendix F) lists the maximum, minimum, and mean concentration for each sampling season that the lake has been monitored through the program.

Chlorophyll-a, a pigment found in plants, is an indicator of the algal abundance. Because algae are usually microscopic plants that contain chlorophyll-a, and are naturally found in lake ecosystems, the chlorophyll-a concentration measured in the water gives an estimation of the algal concentration or lake productivity. **The median (average) summer chlorophyll-a concentration for New Hampshire's lakes and ponds is 4.58 mg/m³.**

2007 Lake Sunapee Deep Spot Chlorophyll-a Data

Stn	2006 Range (min – max) (mg/M³)	Mean Value (mg/m³)	Comparison to NH Median	Comparison to Similar Lake Median	Comments
200	1.94 – 3.06	2.29	Much less than	Slightly greater than	Statistical analysis of the data showed there was no significant increase or decrease in chlorophyll-a since monitoring began. Visual observation showed a variable, fluctuating annual mean. Current year data showed the chlorophyll-a was relatively stable from June through August, and then increased in September.
210	1.64 – 2.30	1.83	Much less than	Slightly less than	Statistical analysis of the data showed there was no significant increase or decrease in chlorophyll-a. Visual observation showed a variable, fluctuating annual mean. Current year data showed a slight increase from June to July followed by a decrease in August and September.
220	1.97– 2.42	2.12	Much less than	Slightly greater than	Statistical analysis of the data showed there was no significant increase or decrease in chlorophyll-a. Visual observation showed a variable, fluctuating annual mean. Current year data showed an overall increase from June to July, decrease from July to August, and increase from August to September.
230	1.61 – 2.89	2.27	Much less than	Slightly greater than	Statistical analysis of the data showed there was no significant increase or decrease in chlorophyll-a. Visual observation showed a variable, fluctuating annual mean. Current year data showed an overall increase from June through August.

Overall, the current year data show that the annual mean chlorophyll-a concentration at Stations 200, 220 and 230 continued to be ***much less than*** the state median and ***slightly more than*** the similar lake median. The mean annual chlorophyll-a concentration at Station 210 was ***much less than*** the state median and ***slightly less than*** the similar lake median. The mean annual chlorophyll concentration at each of the four deep spot stations was ***approximately the same*** during **2007**. It is important to note that the mean annual chlorophyll concentration at each of the four deep spots was lower in **2007** than the unusually high results measured in **2006**.

Lake Sunapee Deep Spot Historic Chlorophyll-a Data

Station	Sampling Period	Annual Mean Range during sampling period (mg/m ³)	Overall Trend
200	1986 - 2007	0.99 - 2.49	Variable*
210	1986 - 2007	0.85 - 4.62 (excluding elevated mean of 4.62 in 1994)	Variable*
220	1993 - 2007	1.06 - 2.83	Variable*
230	1986 - 2007	1.03 - 3.47	Variable*

* = There has been no statistically significant continual increase or continual decrease in the annual mean during the sampling period.

Overall, the statistical analysis of the historical data show that the mean annual chlorophyll-a concentration has **not changed** (either *continually increased* or *continually decreased*) since monitoring began at **Station 200, 210, 220 or 230**. Please refer to Appendix I for the detailed statistical analysis explanation and data print out.

- **Figure 2 and Table 3:** The graphs in Figure 2 (Appendix E) show historical and current year data for lake viewscope transparency. Table 3 B (Appendix F) lists the maximum, minimum and mean viewscope transparency data for each sampling season that the lake has been monitored through the program.

Volunteer monitors use the Secchi-disk, a 20 cm disk with alternating black and white quadrants, to measure water clarity (how far a person can see into the water). Viewslope transparency, a measure of water clarity, can be affected by the amount of algae and sediment from erosion, as well as the natural colors of the water. **The median summer viewslope transparency for New Hampshire's lakes and ponds is 3.2 meters.**

2007 Lake Sunapee Viewscope Transparency Data

Stn.	Range (min-max) meters	Mean Value (meters)	Comparison to NH Median	Comparison to Similar Lake Median	Comments
200	7.40 – 8.11	7.85	Much greater than	Slightly less than	Statistical analysis of the data showed that there was no significant increase or decrease in viewscope transparency since monitoring began. Visual observation showed a variable trend in the annual mean. Current year data showed the viewscope transparency increased gradually from June through August, and then decreased slightly in September. The 2007 annual mean increased from the low in 2006 and was back to a more normal level.
210	7.70 – 8.80	8.21	Much greater than	Slightly less than	Statistical analysis of the data showed that there was no significant increase or decrease in viewscope transparency since monitoring began. Visual observation showed a variable trend in the annual mean. Current year data showed the viewscope transparency increased gradually from June through August, and then decreased in September. The 2007 annual mean increased from the low in 2006 and was back to a more normal level.
220	7.67 – 9.03	8.32	Much greater than	Slightly less than	Statistical analysis of the data showed that there was no significant increase or decrease in viewscope transparency since monitoring began. Visual observation showed a variable trend in the annual mean. Current year data showed the viewscope transparency increased gradually from May through August, and then decreased in September. The 2007 annual mean increased from the low in 2006 and was back to a more normal level.
230	7.65 – 9.28	8.46	Much greater than	Approximately equal to	Statistical analysis of the data showed that there was no significant increase or decrease in viewscope transparency since monitoring began. Visual observation showed a variable trend in the annual mean. Current year data showed the viewscope transparency fluctuated gradually from June through August. The 2007 annual mean increased from the low in 2006 and was back to normal.

The current year data show that the annual mean viewscope transparency at each of the four deep spot stations continued to be ***much greater than*** the state median. Overall, the viewscope transparency at the deep spots ***increased*** as the summer progressed, but ***decreased*** in September. The decreased transparency was likely caused by an increase in chlorophyll-a concentrations in September. Overall, transparency was back to a normal level in 2007 after the decreased mean values in 2006.

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Lake Sunapee Deep Spot Historic Viewscope Transparency Data

Stn.	Sampling Period	Annual Mean Range during sampling period (meters)	Overall Trend
200	1986 - 2007	6.71 – 9.90	Slightly variable*
210	1986 - 2007	6.60 – 9.96	Slightly variable*
220	1993 - 2007	7.07 – 9.50	Slightly variable*
230	1986 - 2007	6.71 – 9.66	Slightly variable*

* = The statistical analysis shows that there has been no continual increase or continual decrease in the annual mean during the sampling period.

Overall, the statistical analysis of the historical data shows that the mean viewscope transparency at the each of the deep spot stations has ***varied slightly, but has not changed overall*** (either *continually increased* or *continually decreased*), since monitoring began. Specifically, the average viewscope transparency has ***fluctuated slightly***, ranging between approximately **6.5 meters and 10 meters** at the deep spot stations since monitoring began. Please refer to Appendix I for the detailed statistical analysis explanation and data print out.

- **Figure 3 and Table 8:** The graphs in Figure 3 (Appendix E) show the amounts of phosphorus in the epilimnion (the upper layer) and the hypolimnion (the lower layer); the inset graphs show current year data. Table 8 (Appendix F) lists the annual maximum, minimum, and median concentration for each deep spot layer and each tributary since the lake has joined the program.

Phosphorus is the limiting nutrient for plant and algae growth in New Hampshire's freshwater lakes and ponds. Too much phosphorus in a lake can lead to increases in plant and algal growth over time. **The median summer total phosphorus concentration in the epilimnion (upper layer) of New Hampshire's lakes and ponds is 12 ug/L. The median summer phosphorus concentration in the hypolimnion (lower layer) is 14 ug/L.**

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2007 Lake Sunapee Deep Spot Epilimnetic Phosphorus Data

Stn.	Range (min- max) ug/L	Mean Value (ug/L)	Comparison to NH Mean	Comparison to Similar Lake Median	Comments
200	<5 - 6	5.3	Much less than	Slightly greater than	Statistical analysis of the data showed that there was no significant increase or decrease in the phosphorus concentration since monitoring began. Visual observation showed an increase (meaning worsening) trend; however values have remained relatively stable since 1993. If worsening trend continues, it will become statistically significant. Current year data showed phosphorus concentration to decrease from June to July and then remain stable from July through September.
210	<5 - 5	5.0	Much less than	Slightly greater than	Statistical analysis of the data showed that there was no significant increase or decrease in the phosphorus concentration since monitoring began. Visual observation showed a fluctuating trend. Current year data showed phosphorus concentration to be relatively stable from May through September.
220	<5 - 5	5.0	Much less than	Slightly greater than	Statistical analysis of the data showed that there was no significant increase or decrease in the phosphorus concentration since monitoring began. Visual observation showed an increasing (meaning worsening), yet variable trend. If worsening trend continues, it will become statistically significant. Current year data showed phosphorus concentration to be relatively stable from May through September.
230	5 - 8	6.3	Much less than	Slightly greater than	Statistical analysis of the data showed that there was no significant increase or decrease in the phosphorus concentration since monitoring began. Visual observation showed a slightly variable, but increasing (meaning worsening), trend. Current year data showed an increase from June to July, and decrease from July to August.

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2007 Lake Sunapee Deep Spot Hypolimnetic Phosphorus Data

Stn.	Range (min- max) ug/L	Mean Value (ug/L)	Comparison to NH Mean	Comparison to Similar Lake Median	Other Comments
200	<5 – 17	8.3	Much less than	Slightly greater than	Statistical analysis of the data showed that the phosphorus concentration has significantly increased since monitoring began. Current year data showed a large increase from June to July, decreased from July to August, and remained stable from August to September.
210	<5 – 5	5.0	Much less than	Slightly less than	Statistical analysis of the data showed that there was no significant increase or decrease in the phosphorus concentration since monitoring began. Visual observation showed a fluctuating trend. Current year data showed the phosphorus concentration remained relatively stable from June through September.
220	<5 – 6	5.3	Much less than	Slightly less than	Statistical analysis of the data showed that there was no significant increase or decrease in the phosphorus concentration since monitoring began. Visual observation showed a stabilizing trend since 2000. Current year data showed the phosphorus concentration remained relatively stable from June through September.
230	5 – 6	6.2	Much less than	Slightly less than	Statistical analysis of the data showed that there was no significant increase or decrease in the phosphorus concentration since monitoring began. Visual observation showed a slightly variable, but increasing (meaning worsening), trend. Current year data showed a relatively stable trend from June through August.

The current year data show that the annual mean epilimnetic and hypolimnetic phosphorus concentration at each of the four deep spot stations continued to be ***much less than*** the state mean. The annual epilimnetic phosphorus concentration was ***slightly greater than*** the similar lake median at each deep spot. The annual hypolimnetic phosphorus concentration was ***slightly greater than*** the similar lake median at Station 200, and ***slightly less than*** the similar lake median at Stations 210, 220 and 230.

The mean epilimnetic phosphorus concentration at each deep spot station was ***approximately the same (within 1.3 ug/L)***. The mean hypolimnetic phosphorus concentration at each deep spot station was ***slightly variable (within 3.3 ug/L)***.

Lake Sunapee Deep Spot Historic Epilimnetic Phosphorus Data

Stn.	Sampling Period	Annual Mean Range (ug/L)	Overall Trend
200	1986 - 1989 1993 - 2006	1.3 - 6.0	Increasing. The statistical analysis showed an increasing phosphorus trend since 1993.
210	1986 - 1989 1993 - 2006	1.8 - 7.4	Variable. The statistical analysis showed that there has been no continual increase or continual decrease in the annual mean during the sampling period.
220	1993 - 2006	2.7 - 6.6	Slightly Variable. The statistical analysis showed that there has been no continual increase or continual decrease in the annual mean during the sampling period. However, visual inspection of the historic trend line indicates a slightly increasing (worsening) trend.
230	1986 - 1989 1993 - 2006	1.8 - 7.3	Slightly Variable. The statistical analysis showed that there has been no continual increase or continual decrease in the annual mean during the sampling period.

Statistical analysis of the historical data for **Station 200** shows that the epilimnetic phosphorus concentration has **significantly increased** (meaning **worsened**) on average by **approximately 2.1 percent** during the sampling period **1986 to 2007**.

Overall, the statistical analysis of the historical data shows that the epilimnetic phosphorus concentration at **Stations 210, 220 and 230** has not changed overall (either *continually increased* or *continually decreased*) since monitoring began. Please refer to Appendix I for the detailed statistical analysis explanation and data print out.

Visual observation of the historic trend line for **Station 220** shows an **increasing (meaning worsening)** epilimnetic phosphorus trend. If the mean annual phosphorus concentration at **Station 220** continues to **increase**, the **increasing (worsening)** trend will become statistically significant.

Visual observation of the historic trend line for **Station 210 and 230** shows a **variable** epilimnetic phosphorus trend since monitoring began.

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Lake Sunapee Deep Spot Historic Hypolimnetic Phosphorus Data

Stn.	Sampling Period	Annual Mean Range (ug/L)	Overall Trend
200	1986 - 2007	1.8 – 8.3	Variable (1986 – 1992) Stabilizing (1993 - 2007)*
210	1986 - 2007	2.0 – 9.7	Variable (1986 – 1992) Stabilizing (1993 - 2007)*
220	1993 – 2007	4.0 – 10.3	Variable (1993 – 2000)* Stabilizing (2001-2007)
230	1986 – 2007	1.7 – 9.0	Variable (1986 – 1995) Decreasing (1996 - 2007)*

* = The statistical analysis has shown that there has been no continual increase or continual decrease in the annual mean during the sampling period.

Overall, the statistical analysis of the historical data shows that the hypolimnetic phosphorus concentration at each of the deep spot stations has ***varied slightly, but has not changed overall*** (either *continually increased* or *continually decreased*), since monitoring began. Please refer to Appendix I for the detailed statistical analysis explanation and data print out.

TABLE INTERPRETATION

➤ **Table 2: Phytoplankton**

Table 2 (Appendix F) lists the current and historic phytoplankton and/or cyanobacteria observed in each monitoring deep spot sample.

2007 Lake Sunapee Deep Spot Dominant Phytoplankton and/or Cyanobacteria

Stn.	200	210	220	230
6/11/07	<i>Dinobryon</i> <i>Asterionella</i> <i>Cyclotella</i>	<i>Dinobryon</i> <i>Asterionella</i> <i>Cyclotella</i>	<i>Dinobryon</i> <i>Asterionella</i> <i>Staurastrum</i>	<i>Dinobryon</i> <i>Asterionella</i> <i>Cyclotella</i>
7/16/07	<i>Staurastrum</i> <i>Asterionella</i> <i>Ceratium</i>	<i>Staurastrum</i> <i>Asterionella</i> <i>Gleocapsa</i>	<i>Staurastrum</i> <i>Asterionella</i> <i>Gleocapsa</i>	<i>Asterionella</i> <i>Staurastrum</i> <i>Gleocapsa</i>
8/14/07	<i>Arthrodesmus</i> <i>Synura</i> <i>Merismopedia</i>	<i>Merismopedia</i> <i>Arthrodesmus</i> <i>Quadrigula</i>	<i>Chrysosphaerella</i> <i>Quadrigula</i> <i>Merismopedia/ Arthrodesmus</i>	<i>Chrysosphaerella</i> <i>Merismopedia/ Quadrigula</i> <i>Arthrodesmus</i>
9/6/07		<i>Asterionella</i> <i>Chrysosphaerella</i> <i>Tabellaria</i>		
9/11/07	<i>Asterionella</i> <i>Chrysosphaerella</i> <i>Tabellaria</i>	<i>Chrysosphaerella</i> <i>Asterionella</i> <i>Tabellaria</i>	<i>Asterionella</i> <i>Tabellaria</i> <i>Chrysosphaerella</i>	

Overall, the dominant phytoplankton observed at the deep spot stations during the 2007 sampling season followed a typical seasonal plankton succession for most lakes. Spring time dominance of **golden-brown algae** (*Dinobryon*, *Chrysosphaerella*) and **diatoms** (*Asterionella*, *Cyclotella*, *Tabellaria*); summer dominance of **green algae** (*Staurostrum*, *Arthrodesmus*, *Quadrigula*) and **cyanobacteria** (*Gleocapsa*, *Merismopedia*); back to a fall dominance of **golden-brown algae** and **diatoms**.

Phytoplankton populations undergo a natural succession during the growing season (Please refer to the “Biological Monitoring Parameters” section of this report for a more detailed explanation regarding seasonal plankton succession). Diatoms and golden-brown algae are typical in New Hampshire’s less productive lakes and ponds.

➤ **Table 2: Cyanobacteria**

In addition to the presence of the cyanobacteria, *Gleocapsa* and *Merismopedia*, one of the three dominant in various samples; a small amount of the cyanobacterium *Anabaena* was observed in the majority of the phytoplankton samples collected at each of the deep spot stations. *Anabaena*, **if present in large amounts, can be toxic to livestock, wildlife, pets, and humans.**

An overabundance of cyanobacteria (previously referred to as blue-green algae) indicates that there may be an excessive total phosphorus concentration in the lake, or that the ecology is out of balance. Some species of cyanobacteria can be toxic to livestock, pets, wildlife, and humans. (Please refer to the “Biological Monitoring Parameters” section of this report for a more detailed explanation regarding cyanobacteria).

Cyanobacteria can reach nuisance levels when phosphorus loading from the watershed to surface waters is increased (this is often caused by rain events) and favorable environmental conditions occur (such as a period of sunny, warm weather).

The presence of cyanobacteria serves as a reminder of the lake’s delicate balance. Watershed residents should continue to act proactively to reduce nutrient loading to the lake by eliminating fertilizer use on lawns, keeping the lake shoreline natural, re-vegetating cleared areas within the watershed, and properly maintaining septic systems and roads.

In addition, residents should also observe the lake in September and October during the time of fall turnover (lake mixing) to document any algal blooms that may occur. Cyanobacteria have the ability to regulate their depth in the water column by producing or releasing gas from vesicles. However, occasionally lake mixing can affect their buoyancy and cause them to rise to the surface and bloom. Wind and currents tend to “pile” cyanobacteria into scums that accumulate in one

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section of the lake. If a fall bloom occurs, please collect a sample (any clean jar or bottle will be suitable) and contact the VLAP coordinator.

➤ **Table 4: pH**

Table 4 (Appendix F) presents the in-lake and tributary current year and historical pH data.

pH is measured on a logarithmic scale of 0 (acidic) to 14 (basic). pH is important to the survival and reproduction of fish and other aquatic life. A pH below 5.5 severely limits the growth and reproduction of fish. A pH between 6.5 and 7.0 is ideal for fish. The mean pH value for the epilimnion (upper layer) in New Hampshire's lakes and ponds is **6.6**, which indicates that the surface waters in state are slightly acidic. For a more detailed explanation regarding pH, please refer to the "Chemical Monitoring Parameters" section of this report.

2007 Lake Sunapee Deep Spot pH

Stn.	Hypolimnion Range (min – max) pH units	Hypolimnion Annual Mean pH units	Epilimnion Range (min – max) pH units	Epilimnion Annual Mean pH units
200	5.87 – 6.32	6.08	6.57 – 6.70	6.63
210	5.88 – 6.42	6.13	6.49 – 6.59	6.55
220	5.87 – 6.43	6.13	6.39 – 6.59	6.50
230	5.99 – 6.35	6.14	6.52 – 6.68	6.60

Overall, the mean pH at the deep spots ranged from a **minimum of 6.08** in the hypolimnion to a **maximum of 6.63** in the epilimnion, which means that the water is **acidic near the lake bottom and slightly acidic near the lake surface**. It is important to point out that the water in the hypolimnion is generally more acidic than in the epilimnion. We typically expect this relationship in lakes. As organic material near the lake bottom is decomposed, acidic by-products are produced which causes a lower pH (meaning higher acidity) in hypolimnion.

It is also important to point out that the mean annual epilimnetic and hypolimnetic pH has **fluctuated slightly** since monitoring began, but **has not continually increased or decreased**.

Due to the presence of granite bedrock in the state and the deposition of acid rain, there is not much that can be done to effectively increase lake pH.

➤ **Table 5: Acid Neutralizing Capacity (ANC)**

Table 5 (Appendix F) presents the current year and historic epilimnetic ANC for each year the lake has been monitored through VLAP.

Buffering capacity or ANC describes the ability of a solution to resist changes in pH by neutralizing the acidic input to the lake. The median ANC value for New Hampshire's lakes and ponds is **4.9 mg/L**, which indicates that many lakes and ponds in the state are "highly sensitive" to acidic inputs. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

2007 Lake Sunapee Deep Spot Acid Neutralizing Capacity

Stn.	Epilimnion Minimum Value (mg/L as CaCO ₃)	Epilimnion Maximum Value (mg/L as CaCO ₃)	Epilimnion Mean Value (mg/L as CaCO ₃)
200	3.1	4.2	3.7
210	3.4	4.6	3.9
220	2.6	4.4	3.5
230	2.4	3.4	2.9

The Acid Neutralizing Capacity (ANC) of the epilimnion (the upper layer) **decreased** during the **2007** sampling season and was **slightly less than** the state median at each of the deep spot stations. Specifically, the mean ANC at Station 230 was the lowest measured since monitoring began in **1993**. In addition, the data indicate that the water in the epilimnion is **moderately vulnerable** to acidic inputs (such as acid precipitation).

Lake Sunapee Historic Deep Spot Acid Neutralizing Capacity

Stn.	Sampling Period	Annual Mean Range during sampling period (mg/L as CaCO ₃)	Overall Trend
200	1993 – 2007	3.4 – 5.8	Slightly variable*
210	1993 – 2007	3.4 – 5.4	Slightly variable*
220	1993 – 2007	3.5 – 5.4	Slightly variable*
230	1993 – 2007	2.9 – 5.7	Slightly variable*

* = No continual increase or decrease evident from visual inspection of the historic data record.

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Overall, the historical data shows that the mean annual epilimnetic Acid Neutralizing Capacity at the deep spot stations has *varied slightly* since monitoring began, ranging from a minimum concentration of **2.9 mg/L** to a maximum concentration of **5.8 mg/L**.

➤ **Table 6: Conductivity**

Table 6 (Appendix F) presents the current and historic conductivity values for tributaries and in-lake data. Conductivity is the numerical expression of the ability of water to carry an electric current. The median epilimnetic conductivity value for New Hampshire's lakes and ponds is **40.0 uMhos/cm**. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

2007 Lake Sunapee Deep Spot Epilimnetic Conductivity

Stn.	Epilimnion Minimum Value (uMhos/cm)	Epilimnion Maximum Value (uMhos/cm)	Epilimnion Mean Value (uMhos/cm)
200	82.00	84.50	83.58
210	82.30	84.50	83.53
220	82.20	84.20	83.23
230	81.50	83.80	82.77

The annual mean epilimnetic conductivity at the deep spot stations ranged from **82.77 to 83.58 uMhos/cm**, which is *much greater than* the state median of **40.0 uMhos/cm**.

Lake Sunapee Deep Spot Historic Epilimnetic Conductivity Data

Stn	Sampling Period	Annual Mean Range during sampling period (uMhos/cm)	Overall Trend
200	1986 – 2007	57.9 (1988) – 103.53 (2005)	Increasing (worsening)
210	1986 – 2007	57.8 (1988) – 103.85 (2005)	Increasing (worsening)
220	1993 – 2007	75.6 (1993) – 103.10 (2003)	Increasing (worsening)
230	1986 – 2007	57.4 (1988) – 103.2 (2005)	Increasing (worsening)

Visual observation of the historic data indicates that the conductivity has increased (worsened) at each of the deep spots since monitoring began. However, the **2007** conductivity results were *lower than* what has been measured **during the last seven years**. It is likely that the dry weather conditions during **2007**

decreased the amount watershed runoff to the lake. Typically, rain events and snow melt cause potentially pollutant laden watershed runoff to reach tributaries and ultimately the lake leading to elevated conductivity levels.

➤ **Table 9 and Table 10: Dissolved Oxygen and Temperature Data**

Table 9 (Appendix F) shows the dissolved oxygen/temperature profile(s) for the 2007 sampling season. Table 10 (Appendix F) shows the historical and current year dissolved oxygen concentration in the hypolimnion (lower layer). The presence of dissolved oxygen is vital to fish and amphibians in the water column and also to bottom-dwelling organisms. Please refer to the “Chemical Monitoring Parameters” section of this report for a more detailed explanation.

The dissolved oxygen concentration was **greater than 100%** saturation near the lake surface and/or within the water column at each of the deep spots on **at least one** sampling event this season. Immediately after lake turnover in the spring, the dissolved oxygen is often supersaturated in the water column. In addition, wave action from wind can dissolve atmospheric oxygen into the upper layers of the water column. As the summer progresses, it is typical to measure supersaturated layers of oxygen closer to the metalimnion, an area where photosynthetic algae are often found.

The Station 210 dissolved oxygen profile conducted in June revealed dissolved oxygen levels **greater than 100%** saturation from 1.0 to 29.0 meters. Typically, layers of algae located in the epilimnion and metalimnion can increase the amount of dissolved oxygen in the water column, since oxygen is a by-product of photosynthesis. However these layers generally occur at the depths which sunlight penetrates the water column, and where nutrients are readily available, and are not typical in the hypolimnion of lakes. Since the percent saturation was greater than 100 percent throughout the water column, this indicates that there may have been a technical problem with the dissolved oxygen meter. Also, it is important to note the sharp decrease in dissolved oxygen on the July sampling event. Dissolved oxygen concentrations ranged between 2.0 and 2.5 mg/L between 4.0 and 30 meters indicating another potential technical problem with the dissolved oxygen meter. Please remember to thoroughly inspect meter probes for air bubbles and membrane solution prior to each sampling event and record any technical difficulties on field data sheets. Or, if this phenomenon continues at Station 210, please notify the VLAP Coordinator to investigate further.

2007 Lake Sunapee Deep Hypolimnetic (bottom meter) Dissolved Oxygen Concentration

Stn.	6/11/07 (mg/L)	7/16/07 (mg/L)	8/14/07 (mg/L)	9/11/07 (mg/L)	10/15/07 (mg/L)
200	2.7 (19 meters)	3.4 (19 meters)	1.0 (20 meters)	1.3 (19 meters)	4.1 (19 meters)
210	8.5 (30 meters)	2.5 (30 meters)	4.1 (30 meters)	5.6 (30 meters)	No profile collected
220	7.6 (24 meters)	9.7 (22 meters)	6.7 (24 meters)	2.3 (23 meters)	No profile collected
230	2.9 (22 meters)	7.7 (22 meters)	6.1 (22 meters)	No profile collected	No profile collected

As stratified lakes (such as **Lake Sunapee**) age and as the summer progresses, oxygen typically becomes **depleted** in the hypolimnion (lower layer) by the process of decomposition. Specifically, the loss of oxygen in the hypolimnion results primarily from the process of biological oxidation of organic matter (i.e.; biological organisms using oxygen to break down organic matter), both in the water column and particularly at the bottom of the lake where the water meets the sediment.

When oxygen levels are depleted to less than 1 mg/L in the hypolimnion (**as it has been on two sampling events at Station 200, three events at Station 210, fifteen events at Station 220, and six events at Station 230 since monitoring began**) the phosphorus that is normally bound up in the sediment may be re-released into the water column, a process referred to as **internal phosphorus loading**.

➤ Table 11: Turbidity

Table 11 (Appendix F) lists the current year and historic data for in-lake and tributary turbidity. Turbidity in the water is caused by suspended matter, such as clay, silt, and algae. Water clarity is strongly influenced by turbidity. Please refer to the “Other Monitoring Parameters” section of this report for a more detailed explanation.

The epilimnetic turbidity of each deep spot sample ranged from **0.29 to 0.80 NTUs** which is **relatively low**. The hypolimnetic turbidity of each deep spot sample ranged from **0.25 to 2.50 NTUs or less**. Turbidity levels above 2.0 NTUs may indicate bottom sediment contamination in the hypolimnion sample. Please make sure to check the Kemmerer bottle for sediment contamination prior to filling the sample bottle.

➤ Table 13: Chloride

The chloride ion (Cl⁻) is found naturally in some surfacewaters and groundwaters and in high concentrations in seawater. Research has shown that **elevated** chloride levels can be toxic to freshwater aquatic life. In order to protect freshwater

aquatic life in New Hampshire, the state has adopted **acute and chronic** chloride criteria of **860 and 230 mg/L** respectively. The chloride content in New Hampshire lakes is naturally low, generally less than 2 mg/L in surface waters located in remote areas away from habitation. The median epilimnetic chloride value for New Hampshire lakes and ponds is **5 mg/L**. Higher values are generally associated with salted highways and, to a lesser extent, with septic inputs. Please refer to the “Chemical Monitoring Parameters” section of this report for a more detailed explanation.

Based on historical chloride data, we recommend that your monitoring group continue to conduct chloride sampling in the epilimnion at each deep spot to determine long term trends. In addition, we recommend that your monitoring group conduct conductivity and chloride sampling in the inlet tributaries located near salted roadways, particularly in the winter and spring during melt events and rain events, and periodically during summer rain events.

Furthermore, if your monitoring group has conducted any independent conductivity and/or chloride sampling investigations, we request that you submit this data to the VLAP coordinator. Sharing of this data will allow DES to not only assist your group in determining the extent and severity of chloride pollution in the Lake Sunapee watershed, but also to assess the extent and severity of chloride pollution throughout the state.

In addition, if your group is concerned about salt use on a particular roadway, we recommend contacting the Town Road Agent or the Department of Transportation to discuss the implementation of a low-salt area near the lake and/or its major tributaries.

Furthermore, we recommend that the association also work with watershed residents to reduce the use of salt on private roads, driveways, and walkways. Watershed residents should be encouraged to implement a “low salt diet” for their property. For guidance, please read the 2005 DES Greenworks Article “Salt: An Emerging Issue for Water Quality” (January 2005) which can be accessed at www.des.nh.gov/gw0105.htm or from the VLAP Coordinator.